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Case Report

Laser Pointer Induced Maculopathy: First Case Report in a Pediatric Portuguese Patient

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Abstract

Purpose: To report a case of laser induced maculopathy in a child.

Methods: A eleven-year-old-healthy boy presents to the emergency room with sudden bilateral visual loss for four days. He denied any previous trauma or known etiology. His best corrected visual acuity (BVCA) was 20/200 for far and 20/100 for near, with both eyes. Fundus examination revealed bilateral foveal yellowish-orange ("Best-like") lesions. Optical coherence tomography (OCT) showed bilateral disruption involving mainly the outer retinal layers. OCT-angiography showed vascular rarefaction on choriocapillaris. A second more thorough anamnesis revealed the boy had been playing with a high power (up to 1000mW) green laser in front of a mirror five days prior. As such, a laser pointer-induced maculopathy diagnosis was assumed and treatment with oral prednisone (1 mg/Kg/day) and topical nepafenac 0.1% for four weeks was instituted. Eighteen months after, his BCVA improved to 20/32 for far and 20/50 for near and fundoscopy shows foveal retinal pigment mottling, with almost no OCT translation.

Conclusion: The safety of laser pointers is a growing major public health concern, especially within the pediatric population. A high degree of suspicion is needed as children most times don't associate/don't want to confess a previous laser exposure. Tighter regulations and awareness campaigns are of uttermost importance.

Keywords: *Laser Pointer; Maculopathy; Pediatric; Photic Retinopathy*

Introduction

LASER ("light amplification by stimulation emission of radiation") has become an important tool of everyday life as they are used for medical and industrial purposes. Laser pointers are small handled devices intended to highlight an object of interest with a small bright colored light and are particularly useful in business and educational settings. However, they have been increasingly used for recreational purposes, like toys.

The photothermic effect depends on several factors such as laser radiation power, exposure time and wavelength and can lead to blindness. For visible spectrum, the retina is the primary ocular site of injury and the morphology of retinal damage is highly variable, ranging from outer retina disruption to macular holes [1].

Most commercially available laser pointers have a theoretically negligible ocular damage. However, most of the "laser toys" are high-power laser pointers (≥ 5mW of power), which can be hazardous, and are frequently mislabeled and easy to obtain in the internet. This effortless availability led to an increasing number of laser-induced ocular injuries, both accidental and intentional, especially in the pediatric population [2].

The purpose of this paper is to report, for the first time in Portugal, a case of a self-induced bilateral laser pointer induced maculopathy in a pediatric patient and to highlight the need for tighter regulations and awareness campaigns. Parental consent has been obtained to publish this case (including publication of images).

Case Report

An eleven-year old healthy boy presented to the emergency room with sudden bilateral vison loss for four days.

On ophthalmological examination, his best corrected visual acuity (BVCA) was 20/200 for far and 20/100, with both eyes. Pupillary reflexes were unremarkable, with no afferent pupillary defect. Extra-ocular movements were unimpaired. Intraocular pressure was 15mmHg in the right eye and 14 mmHg in the left. Slit lamp biomicroscopy showed no abnormalities on anterior segment of either eye. Fundus examination revealed bilateral foveal yellowish-orange ("Best-like") lesions (Figure 1). Optic discs were unremarkable. Optical Coherence Tomography (OCT) showed bilateral disruption involving mainly the outer retinal layers (Figure 2). A *de novo* heredo-dystrophy disease was though as primary culprit, but a second more thorough anamnesis revealed the boy had been playing with a high power (up to 1000 mW) green laser in front of a mirror five days prior (Figure 3). As such, a laser pointer induced maculopathy was assumed and treatment with oral prednisone (1 mg/Kg/day), progressively tapered, and topical nepafenac 0.1% for four weeks was instituted.

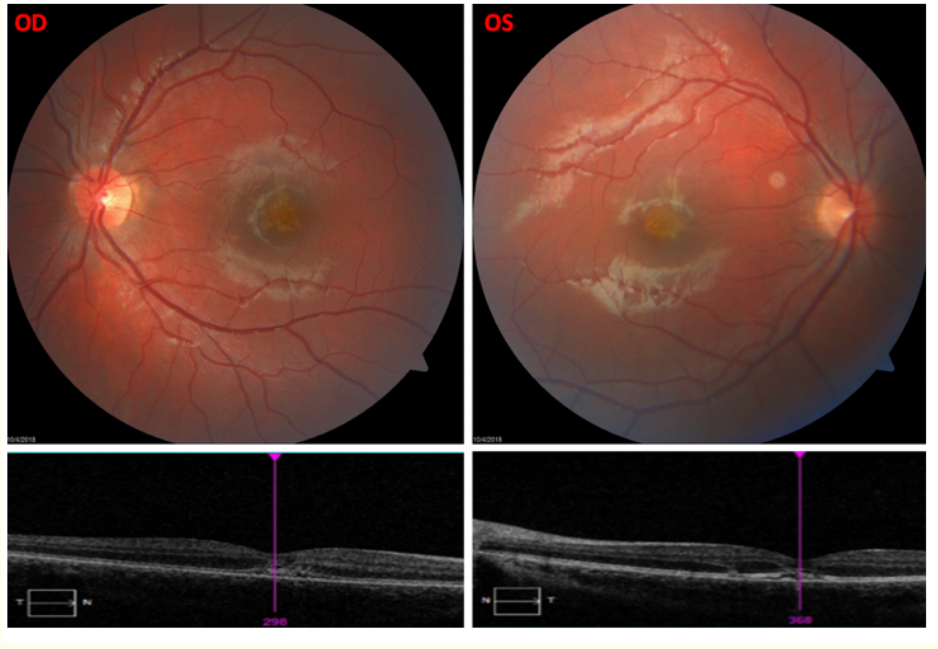

Figure 1: *Initial presentation. On the top, bilateral foveal yellowish-orange lesions. On the bottom, OCT showing disruption involving mainly the outer retinal layers. OD: Right eye; OS: Left eye; OCT: Optical Coherence Tomography.*

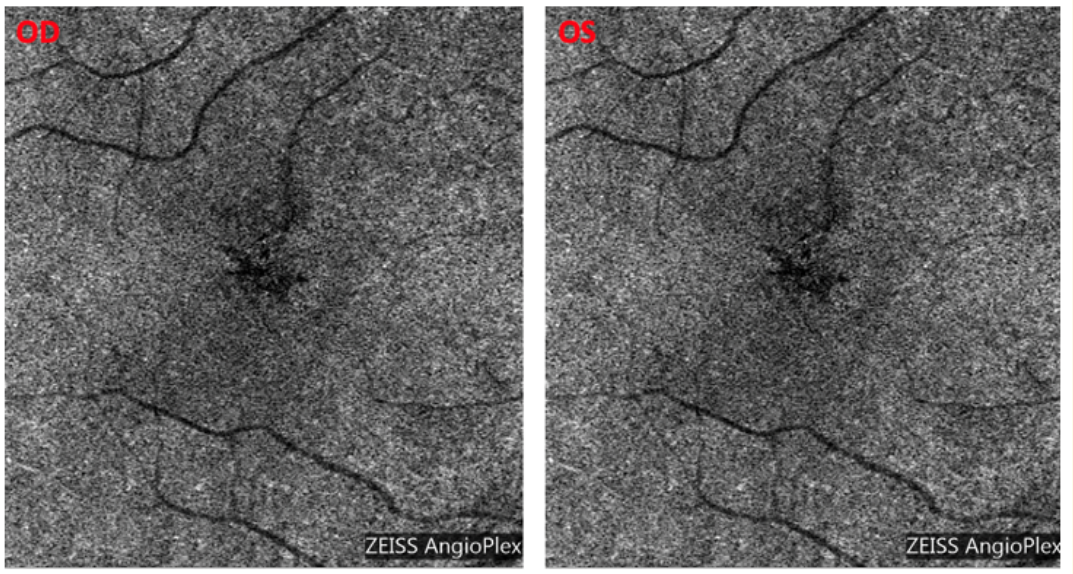

Figure 2: *OCT-A showing bilateral choriocapillaries rarefaction as black spots around the centre. OCT-A: Optical Coherence Tomography Angiography.*

Figure 3: *Green laser pointer. Note the high power (< 1000 mW).*

Five days after the first observation, fundoscopy pictures was already vastly different, seeming much less exudative and structural OCT showed much less alterations. OCT-angiography showed vascular rarefaction on choriocapillaries.

The child maintained close follow-up and his BCVA progressively improved with photochromatic lens graduated with -0.5 diopters bilaterally. Eighteen months after, his BCVA improved to 20/32 (although with crowding effect) for far and 20/50 for near. Fundoscopy shows foveal retinal pigment mottling, with almost no OCT and OCT-A translation. The evolution of retinal findings is presented on figure 4.

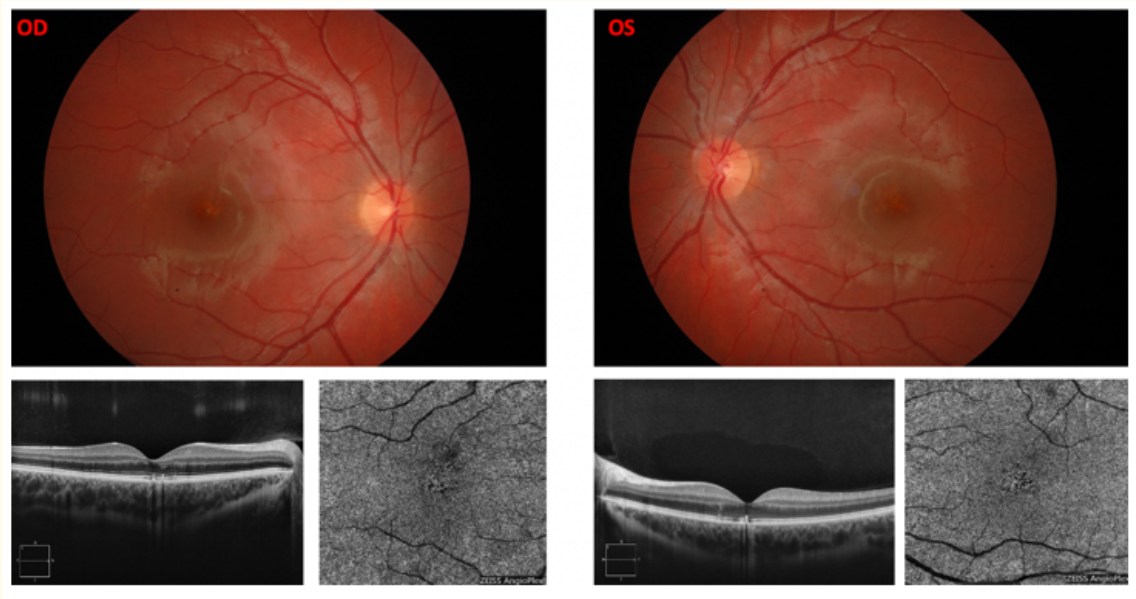

Figure 4: *18 months after injury. Despite visual acuity improvement, the OCT and OCT-A did not resolve.*

As vision loss was bilateral and severe a school low vision program had to be institute since fist observation, so that the child could keep up with his educational needs.

Discussion and Conclusion

In the past few years, an increasing number of laser pointer induced injuries have been reported and they are now considered a major public health concern [3]. The lack of control of these devices and the ease to obtain them, turned their educational into recreational purpose.

The problem is that lasers can induce severe ocular injuries and in the visible spectrum wavelength the retina is the main affected structure. The retinal damage occurs mostly due to photothermal effect that increases the temperature leading to protein denaturation and cell death, which is more pronounced with short-wavelength light (green laser pointers). Retinal pigmented epithelium (RPE) is especially affected due to high concentration of melanin, which absorbs light [4]. The type and extent of retinal injuries depend on physical properties of laser, such as the wavelength of emission, the power and the duration of exposure [5] and on host characteristics.

The laser pointers are classified according to European Standard DIN EN 60825-1 into four classes [6]. Only laser pointers up to laser class 2 use (< 1 mW) are allowed to use due to negligible ophthalmological hazard. Class 3B and 4, high-power lasers, could lead to retinal injury even after an accidental exposure. They are considered as weapons and not legally available for sale [6].

Blue lasers, with a wavelength of 445 nm, focus on vitreoretinal interface and typically results in full thickness macular holes or prehyaloid hemorrhages [7]. Red lasers (635 nm) cause RPE changes but require some time of exposure [8]. Green lasers (532 nm) have high affinity to melanin and absorb well in RPE, leading to outer retinal damage [9]. These green lasers are commercially available ranging from 1 to 5000 mW of power and the majority of laser induced maculopathies are related to their misuse. Our patient had been playing with a class 4 high power (up to 1000 mW) green laser in front of a mirror and presented with a laser induced maculopathy.

Laser induced maculopathy appearance may resemble other retinopathies and the differential diagnosis requires a high level of suspicion, especially when presenting bilaterally, since most laser injuries are unilateral [2]. Genetical retinal diseases should be ruled out, in particular Best Disease but it usually has slow progression and affects visual acuity later in life [10].

Although RPE is known to be primarily damaged by laser, Tomasso., *et al.* suggested that laser injury could also involve the choriocapillaris and multimodal imaging could be useful for diagnosis [11]. Our case agrees with them, as we found hypointense lesions in OCT-A corresponding to focal hyperreflectivities detected on structural OCT.

Shortly after laser pointer exposure, patients often complaint of visual acuity impairment but some may only refer the existence of paracentral scotomas [12]. Although structural retinal damage tends to persist over time, the majority of patients show a complete recovery over some months after injury, particularly if the injured was extra-foveal. A minority of patients have permanent reduced visual acuity [12], either by the primary injury itself or due to later complications such as secondary choroidal neovascularization [13].

Although the recommendations for systemic therapy are not clear, patients are usually treated with oral corticosteroids and topical nonsteroidal anti-inflammatory drugs (NSAIDS). Several reports have shown a benefit in visual acuity and OCT findings with this combination therapy [5,14]. NSAIDs have been shown to improved photoreceptor survival with laser injuries and are thus recommended [15]. Our patient received oral prednisone (1 mg/Kg/day) and topical nepafenac 0.1% for four weeks. His BCVA progressively improved with almost no OCT translation. These findings lead us to think that inflammatory response is responsible for the acute stage impairment. Although structural outer retina and choriocapillaris damage is everlasting, the progressively reduced inflammation is accompanied by visual acuity improvement.

The safety of laser pointers is a growing major public health concern, especially within the pediatric population. Unfortunately, many of high-power "military" lasers are mislabeled and still commercially available. As persistent retinal damage and functional impairment may persist, tighter regulations and awareness campaigns are of uttermost importance. Moreover, in cases of persistent ocular lesions in children, one may anticipate the need for special educational programs and special work needs in the future.

Disclosure Statement

The authors have no conflicts of interest to declare.

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